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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/770,385	01/29/2001	H. Daniel Dulman	M4065.0376/P376	7102

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EXAMINER

MOHAMEDULLA, SALEHA R

ART UNIT	PAPER NUMBER
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1756

DATE MAILED: 11/06/2002

41

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/770,385

Applicant(s)

DULMAN ET AL.

Examiner

Saleha R. Mohamedulla

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 29 January 2001.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-44 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-8, 12-29 and 36-44 is/are rejected.
- 7) ☒ Claim(s) 9-11 and 30-35 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Claims 1-44 are pending.

Information Disclosure Statement

1. The front face of the application shows that an IDS was entered on May 2, 2001 in Paper No. 3. However, the IDS is not in the file. The examiner requests applicant's assistance in obtaining the IDS, if it was indeed filed, along with the returned postcard receipt.

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 19-27, 36, 37 and 39-44 are rejected under 35 U.S.C. 102(b) as being anticipated by US# 5,955,222 to Hibbs et al.

Hibbs teaches a method of making a phase shift mask. As shown in Figure 4, a mask substrate, made of fused silica, or quartz (col. 5, lines 45-60) is provided. The substrate is covered with an opaque blocking layer made of chromium (col. 6, lines 1-5). As illustrated in Figure 4b, portions of the blocking opaque layer are removed using known masking and etching techniques (e.g., reactive ion etching in a chlorine and oxygen ambient or a wet etch technique) so as to form plurality of openings to expose underlying portions of the top surface of the transparent substrate (col. 6, lines 14-20). The configuration of the pattern formed corresponds

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to the configuration of the pattern desired to be exposed in a resist layer on a semiconductor wafer (col. 6, lines 20-25). Figure 4c shows that a hybrid resist is deposited on the remaining portions of blocking layer and covers the exposed top surface of the substrate (col. 6, lines 25-30). As the next step, also illustrated in Figure 4c, the hybrid resist layer is exposed to electromagnetic radiation transmitted through the substrate from the bottom of the substrate (col. 6, lines 38-42). The electromagnetic radiation propagates through the substrate and activates those portions of the resist layer where an intermediate amount of electromagnetic radiation, probably due to the diffraction patterns, occurs, that is, portions 134 (col. 6, lines 40-45).

Hibbs teaches that the hybrid resist layer is "activated" when it is exposed to light of sufficient intensity and for a sufficient period of time to change the chemical structure thereof when compared to portions that are otherwise exposed, i.e., portions wherein the light reactions have been completed and portions wherein no exposure has occurred (col. 6, lines 45-60). Hibbs teaches that in the preferred embodiment, the activated areas are located above the borders or vertical sidewalls of the openings in the blocking layer. Hibbs teaches that, as shown in Figure 4d, activated portions of the resist layer are removed by appropriate developing processes of the type well known in the art. Following such developing, surface portions and blocking portions are exposed, the centers of the activated areas are aligned substantially directly above the vertical sidewalls of the first layer of the opaque blocking material (col. 6, lines 60-65). As shown in Figure 4e, recessed portions are formed in the substrate and are carefully controlled so that the electromagnetic radiation passing through the mask would be 180 degrees out of phase with the electromagnetic radiation passing through un-etched substrate

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features 117 (col. 7, lines 1-15). Any portions of resist layer remaining after this final etching of the substrate are removed using known processes.

Hibbs teaches in an alternative embodiment that an anti-reflective coating is used on the surface of the opaque blocking layer (col. 7, lines 25-40). The exposed chrome portion can be removed prior to the quartz etch, but after developing the resist, i.e., between the steps illustrated in Figures 4d and 4e. Hibbs teaches that in this manner, little to no damage is done to the anti-reflective coating during the quartz etching step, and the printed image quality is maintained. Hibbs teaches that exposure using the hybrid resist creates a space/line/space combination (col. 7, lines 40-55). Figure 15 shows a line pattern for positive resist printed with a reticle line pattern. Because Hibbs teaches the space/line/space combination in Figure 4f, Hibbs teaches the claim 37 and 39 limitations drawn to at least one printable area self-aligned with respect to an adjacent phase shift area and that the printable area comprises a line. The phase shift mask is a reticle that comprises a chromium opaque layer and a quartz substrate. The printable area is located within the substrate and the phase shift area is located in the opaque layer. Therefore, Hibbs teaches the limitations of claims 40-43. Because Hibbs teaches an anti-reflective layer over the opaque layer, Hibbs teaches the claim 44 limitations that the mask comprises a layer overlying the opaque layer where the printable contact area would be formed in the opaque layer and the adjacent phase shift layer would be formed in the layer. Claims 19 and 36 are product by process claims and are drawn to a mask with either one or two layers on a substrate. Hibbs teaches a substrate with an anti-reflective coating and an opaque layer thereon. Therefore, the limitations of claims 19 and 36 are met.

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Hibbs also teaches claim 20 limitations drawn to forming an opaque layer over a substrate, where the opaque layer has an opening filled with a first material. The openings in the opaque layer are shown in Figure 4b, and the first material is the resist with portion 134. Areas 134 define portions of the substrate which are to be removed. As described with respect to figures 4d and 4e, the first material is used as a mask to remove the areas of the substrate and the first material is removed in figure 4f. Hibbs also teaches claim 21, 22 and 23 limitations because part of the first material forms first regions 134 that etch the substrate and a second regions that do not etch the substrate. The first and second regions have 180 degree phase shift characteristics because the substrate is etched under one region and the substrate is not etched under the second region. Claim 24 is met as Hibbs teaches a rim type phase shift mask. Claim 25-27 are met as plural regions of the substrate are etched and plural regions are not etched.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 1-8, 12-18, 28, 29 and 38 rejected under 35 U.S.C. 103(a) as being unpatentable over US# 5,955,222 to Hibbs et al.

5. Hibbs teaches the limitations discussed above in paragraphs 1 and 2. Hibbs teaches a method of making a rim-type phase shift mask as discussed above. Hibbs teaches that the mask is used to form a line pattern but does not specifically teach the claim 38 limitation that the mask

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can be used to form a contact hole pattern. Hibbs teaches that rim-type phase shift masks are used to make contact holes (col. 2, lines 1-10). It would be obvious to one of ordinary skill in the art to use the rim-type mask to make contact holes as Hibbs teaches that rim-type masks are conventionally used to make contact hole patterns (col. 2, lines 1-10).

6. Hibbs teaches, as illustrated in Figure 4b, portions of the blocking opaque layer are removed using known masking and etching techniques (e.g., reactive ion etching in a chlorine and oxygen ambient or a wet etch technique) so as to form plurality of openings to expose underlying portions of the top surface of the transparent substrate (col. 6, lines 14-20). Hibbs teaches claim 29 limitations that the opening is deepened into the substrate as shown in Figure 4f. Hibbs does not specifically teach the claim 28 limitations of using a resist to pattern the opaque layer. It would be obvious to one of ordinary skill in the art to use a resist to pattern the opaque layer as Hibbs teaches known masking and etching techniques, and resist patterning is conventional in the art. The resist would be removed to form the structure in Figure 4b.

7. Hibbs teaches the limitations of claim 1, as discussed above in paragraphs 1 and 2, drawn to forming an opaque layer, filling the opaque layer with resist that defines areas of the substrate to be removed, using the resist to remove areas of the substrate and removing the resist. Hibbs teaches the limitations of claims 2-7 and 12 as discussed above in paragraphs 1 and 2, and the limitations of claim 8 as discussed in paragraph 6. Hibbs teaches chromium and a quartz substrate and therefore, teaches the limitations of claims 16-18. Hibbs also teaches an anti-reflective layer on top of the opaque layer, but does not teach that a first layer of material underlies the opaque material. Anti-reflective materials include molybdenum silicide and chromium fluoride, therefore, Hibbs teaches claim 13-15 limitations. Hibbs teaches that mask

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exposure is performed from the underside of the substrate, as shown in Figure 4c. It would be obvious to one of ordinary skill in the art to form the anti-reflective layer under the opaque material in order to use the mask to perform exposure from the top side of the substrate. The anti-reflective layer would prevent scattering when light passes through the substrate from the top. One of ordinary skill in the art would perform exposure from the top side of the substrate as it is conventional to perform mask exposure from both the top and bottom sides of the substrate.

Allowable Subject Matter

8. Claims 9-11 and 30-35 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. The prior art does not teach or suggest providing the first material within the opening or deepened opening and over the opaque layer, directing a first exposure through the substrate to expose a portion of the first material, hardening or baking the exposed portion of the first material, directing a second exposure at said first material to remove unhardened portions, providing a second material over the opaque layer and hardened portions, performing a lithographic step on a portion of the second material overlying and bounded by the first material to expose and remove the portion of the second material, and etching the opaque layer underlying the exposed and removed portion of the second material.

Conclusion

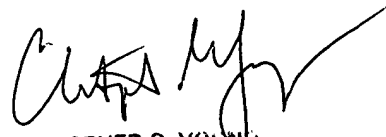
9. Any inquiry concerning this communication or earlier communications from the Examiner should be directed to Saleha Mohamedulla whose telephone number is (703) 308-1260. The Examiner can normally be reached Monday-Friday, from 8:00 AM to 4:30 PM. If attempts to reach the Examiner by telephone are unsuccessful, the Examiner's supervisor, Mark

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Huff, can be reached on (703) 308-2464. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9310. The After Final fax phone number is (703) 872-9311. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

srn *SRN*

November 1, 2002


CHRISTOPHER G. YOUNG
PRIMARY EXAMINER